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FINAL REPORT

Assessment of
Geology, Energy, and Minerals (GEM)
Resources

ALVORD DESERT
GEM RESOURCE AREA

(OR-023-19)

HARNEY COUNTY, OREGON

Prepared for

United States Department of the Interior
United States Bureau of Land Management
Scientific Systems Development Branch

March 1983

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**Assessment of
Geology, Energy, and Minerals (GEM)
Resources**

**Alvord Desert GRA
(OR - 023 - 19)
Harney County, Oregon**

Prepared For:

**United States Department of the Interior
United States Bureau of Land Management
Scientific Systems Development Branch**

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BLM Contract No.: YA - 553 - CT2 - 1042

March, 1983

**This report was prepared as part of a Phase I Assessment of GEM
Resources within designated Wilderness Study Areas in Oregon, Idaho and
Nevada.**

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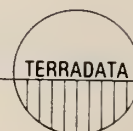
- o Dr. Antonius Budding - Oil Shale and Tar Sands
- o Mr. Raymond Corcoran - Field Verification
- o Dr. James Firby - Paleontology
- o Mr. Ralph Mason - Coal
- o Mr. Richard Miller - Uranium and Thorium
- o Mr. Vernon Newton - Oil and Gas
- o Mr. Herbert Schlicker - Industrial Minerals and Geologic Hazards
- o Dr. Walter Youngquist - Geothermal
- o Dr. Paul Weis - Metals and Non - Metals.

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Ms. Pamela Ruhl provided clerical and editorial assistance throughout the project. Ms. Sara Mathews assisted with occurrence information and drafting. Mr. Philip R. Jones and Mr. Michael A. Becker produced all documents relating to the project using TERRADATA's word processing and document production systems.



EXECUTIVE SUMMARY

The purpose of this project is to evaluate and classify environments favorable for the occurrence of GEM resources in southeastern Oregon, southwestern Idaho, and northern Nevada. (See the TERRADATA report entitled "Procedures for the Assessment of Geology, Energy, and Minerals (GEM) Resources.") GEM resource environments have been rated on a scale that ranges from one to four, with one being least favorable and four being most favorable. Favorability classes two and three represent low and moderate favorability, respectively. Confidence levels range from A to D with A being low confidence and D being high confidence. The confidence levels are directly related to the quantity and quality of the information available for the determination of the favorability classes.

The specific area with which this report deals is the Alvord Desert GEM resource area (GRA OR-023-19) which is located in southeastern Oregon (see location map, below). The Alvord Desert GRA contains about 756 square miles within Townships 33S through 36S and Ranges 34E through 39E. It contains two WSAs; WSA 2-73A, and WSA 2-74 which comprise 245,365 acres. The study area is in the Andrews and Southern Malheur Resource Areas of the Burns and Vale BLM Districts. It is about 60 miles from Burns, Oregon.

The Alvord Desert GRA is within the Great Basin sub-province of the Basin and Range physiographic province. It is underlain by rocks that range from Paleozoic miogeoclinal sediments to Tertiary volcanics and volcanoclastic strata. Pre-Tertiary rocks are not exposed in the area. The area is west of the major structural Antler orogenic belt. Basin and Range fault blocks are common in the portion of Oregon.

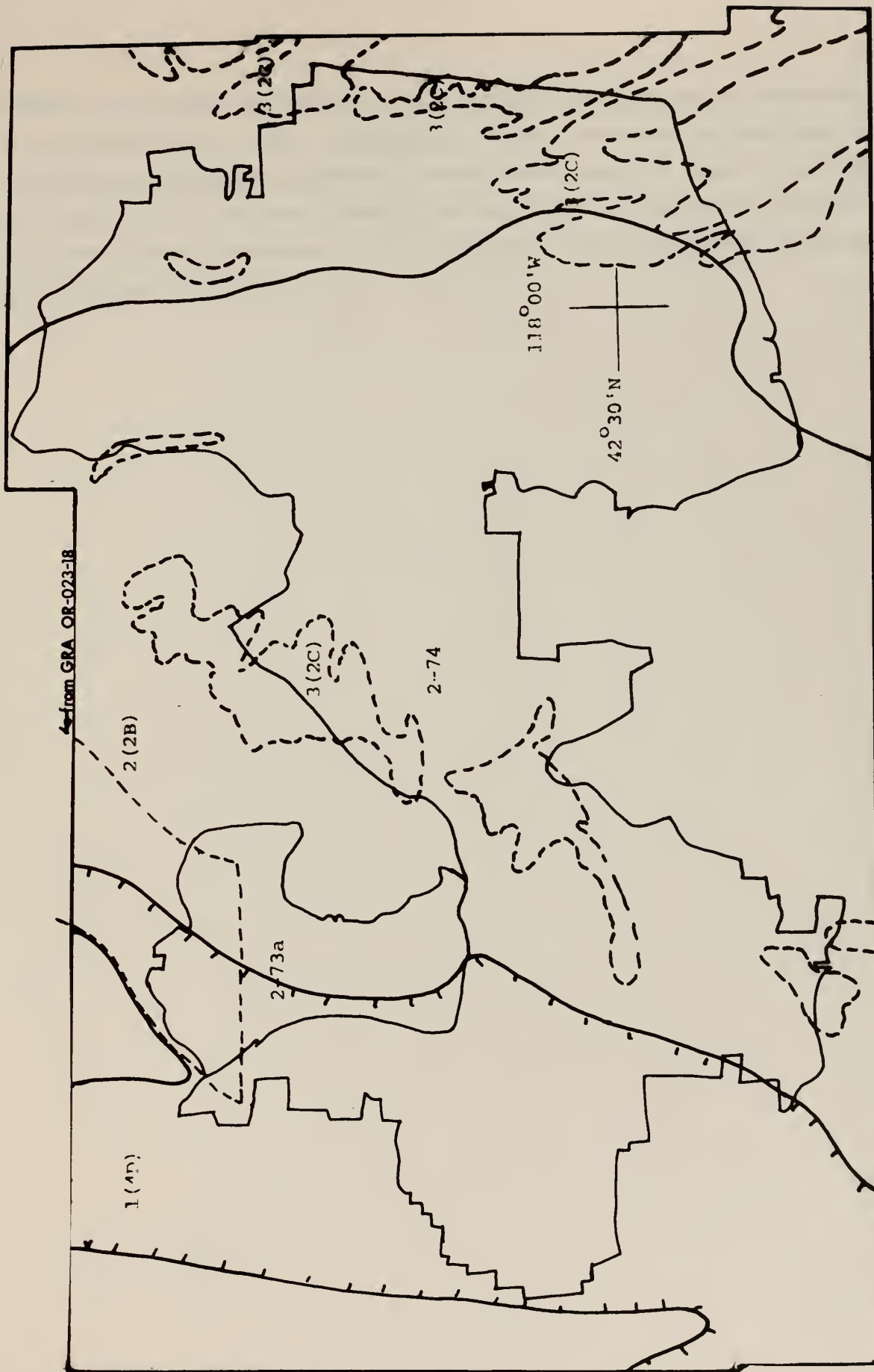
The Alvord Desert GRA contains several geologic environments that are variously favorable for GEM resources. A part of the study area is classified 4D for the occurrence of geothermal resources. The 4D rating signifies that the geologic environment, the inferred geologic processes, and the known deposits indicate high favorability for geothermal resources, and that the available data provide direct evidence and are quantitatively substantial to support the possible existence of this resource. The study area also contains environments that are moderately favorable (Class 3) for oil and gas resources. The area has a low favorability (Class 2) for metals, coal, clinoptilolite, and diatomite resources. It is least favorable (Class 1) for uranium and thorium, oil shale and tar sands, and limestone resources.



GRA Location Map



Land Classification Map
 Alvord Desert GRA
 (OR - 023 - 19)
 Harney County, Oregon



Scale 1:250,000
 (Adel and Jordan Valley 1°x2° NTMS Quadrangle)



TERRADATA recommends that further surface geologic investigations be undertaken in the Alvord Desert GRA in order to increase confidence levels in the classifications. Detailed geologic mapping and geochemical investigations would be useful in upgrading the land classification of this area. Selective drilling of geochemical and/or geophysical anomalous areas would contribute to the refinement of the confidence levels and favorability ratings in this GRA.



**Classification Of Lands Within The
Alvord Desert GRA
(OR - 023 - 19)
Harney County, Oregon
For GEM Resource Potential**

<u>COMMODITY</u>	<u>AREA</u>	<u>CLASSIFICATION LEVEL</u>	<u>CONFIDENCE LEVEL</u>	<u>REMARKS</u>
Metals	Entire GRA	2	B	Hg
Geothermal	Area 1-4D	4	D	
	Area 2-2B	2	B	
	Rest of GRA	1	B	
Uranium/Thorium	Entire GRA	1	A	
Coal	Entire GRA	2	C	
Oil and Gas	Entire GRA	3	B	
Tar Sands/Oil Shale	Entire GRA	1	C	
Limestone	Entire GRA	1	C	
Bentonite	Area 3-2C	2	C	
	Rest of GRA	1	B	
Diatomite	Area 3-2C	2	C	
	Rest of GRA	1	B	
Clinoptilolite	Entire GRA	2	C	
Paleontology	Entire GRA	3	C	
Hazards	See Hazards Map (GRA File)			
ESLs	None	1	C	

LEGEND:

Class 1 - Least Favorable
Class 2 - Low Favorability
Class 3 - Moderate Favorability
Class 4 - High Favorability

Confidence Level A - Insufficient data or no direct evidence
Confidence Level B - Indirect evidence available
Confidence Level C - Direct evidence but quantitatively minimal
Confidence Level D - Abundant direct and indirect evidence



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1. INTRODUCTION

This report is one of 27 GRA technical reports that summarize the results of a Phase I assessment of the geology, energy, and minerals (GEM) resources in selected portions of southeastern Oregon, southwestern Idaho, and northern Nevada. The study region was subdivided into 27 GEM resource areas (GRAs), principally for ease of data management and interpretation. The assessment of GEM resources for this project consisted of an interpretation of existing literature and information by experts knowledgeable in both the geographic area and specific commodities. A limited stream sediment sampling program also was conducted. It is possible that the assessment would be different if detailed field exploration, geochemical sampling, and exploratory drilling programs were undertaken. (See the TERRADATA report entitled "Procedures for the Assessment of Geology, Energy, and Minerals (GEM) Resources.")

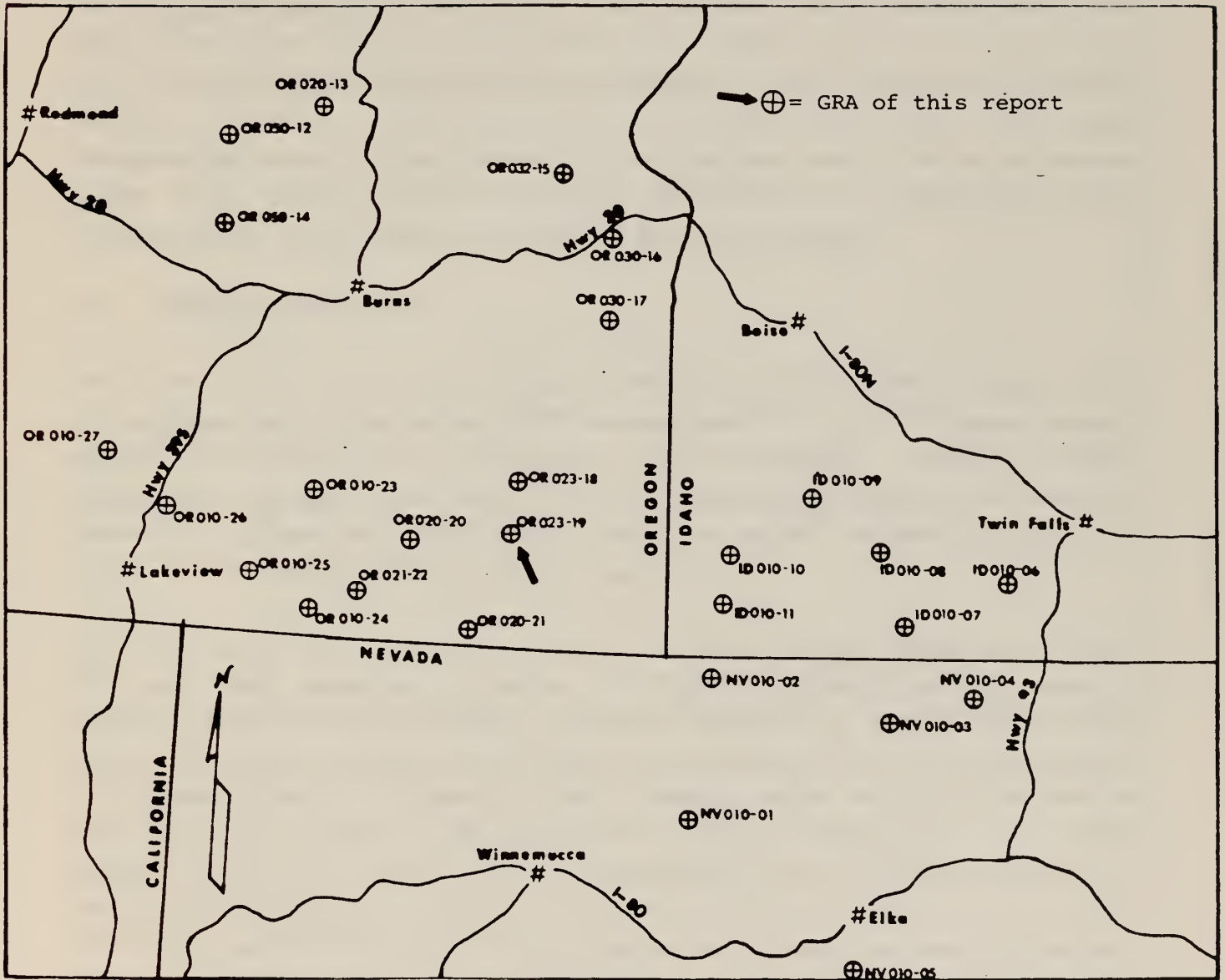
This report summarizes the assessment of the GEM resources potential of the Alvord Desert GRA (OR-023-19). See Figure 1-1. Commodity categories for which this GRA was evaluated are:

- o Metals
- o Oil and Gas
- o Oil Shale and Tar Sands
- o Geothermal
- o Uranium and Thorium
- o Coal
- o Industrial Minerals
- o Paleontological Resources
- o Geologic Hazards
- o Educational and Scientific Localities (ESLs)

Geologic environments within the Alvord Desert GRA have been rated with respect to their favorability for the occurrence of these different commodities. The favorability rating scale ranges from one to four, with one being least favorable and four being most favorable. Confidence levels in these ratings also have been assigned. These confidence levels range from A to D, with A being low confidence and D high confidence. Assigned confidence levels are related to the quantity and quality of the information available for the determination of the favorability ratings.



FIGURE 1-1
GRA Location Map



2. DESCRIPTION OF THE ALVORD DESERT GRA

2.1 LOCATION

The Alvord Desert GRA (OR-023-19) is in southeast Oregon. It lies between latitudes 42°28'N and 42°45'N and longitudes 117°53'W and 118°37'W. The Alvord Desert GRA contains approximately 756 square miles within Townships 33S through 36S and Ranges 34E through 39E (see Figures 1-1 and 2-1). The area contains two Wilderness Study Areas (WSAs); WSA 2-73A (21,395 acres), and WSA 2-74 (223,970 acres). The Alvord Desert GRA is in the Andrews and Southern Malheur Resource Areas of the Burns and Vale BLM Districts. The area is about 60 miles from Burns, Oregon which is the nearest transportation center offering a minimum of rail, highway, and/or charter-air services. Access to the contained WSAs is via county maintained dirt or packed-gravel roads. Vehicular access to the interior of the WSAs is poor to non-existent.

2.2 GENERAL GEOLOGY

The Alvord Desert GRA is in the Adel and Jorden Valley 1°x2° NTMS Quadrangles. The data available for this area include NURE investigations^{(1, 2, 3, 4, 5, 6)*}, general mineral resource information⁽⁷⁾, and small-scale geologic mapping⁽⁸⁾. Detailed geologic information is lacking in most areas. Occurrence information evaluated for the Alvord Desert GRA includes MILS, CRIB, NURE, claims, and leases. The overall quantity and quality of commodity specific information is poor.

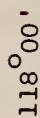
The Alvord Desert GRA is within the northern section of the Great Basin portion of the Basin and Range physiographic province. The Basin and Range Province consists of generally north-trending fault-block mountains separated by parallel intermontane basins. The mountain blocks are commonly ten to twelve miles wide and are separated by alluviated valleys of comparable width. Elevation ranges from below sea-level at Death Valley to more than 13,000 feet at White Mountains Boundary Peaks. Local relief generally is less than 5,000 feet. The physiography of the Great Basin reflects the structural and lithologic complexity of the underlying bedrock. The Great Basin portion of the Basin and Range Province extends from southern Nevada northward into southern Oregon. The northern-most extremity is located just north of the town of Burns, Oregon.

* In this report, citations are superscripted numbers. They refer to bibliographic entries listed in Appendix A, References Cited.



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**Topographic Map
Alvord Desert GRA**



Scale 1:250,000

The part of the Basin and Range Province that lies in southern Oregon extends eastward from the Cascade Range to the eastern limits of the Trout Creek Mountains. This part of the Province is dominantly underlain by Cenozoic volcanic strata. Pre-Tertiary rocks are exposed in only two places in the Oregon part of the Basin and Range Province; in the Pueblo Mountains and in the Trout Creek Mountains of southeastern Harney County. Very little is known about the Pre-Tertiary basement in this area. A sparse amount of data is available regarding the depth to the Pre-Tertiary basement rocks and the thickness and nature of the Tertiary cover rocks.

2.2.1 Geomorphology

The most distinguished feature of the Alvord Desert GRA is the bolson-playa that occupies the Alvord Desert graben. This complex is bounded on the east and west by north-trending normal faults. Active degradational processes have caused the fault-scarps to recede leaving a narrow pediment surface adjacent to the playa. Around the margins of the playa are a series of strand line ridges that reflect levels of Alvord Lake during Pluvial times. Much of the beach material has been reworked into sanddunes, particularly in the south.

The block that forms the eastern margin of the Alvord Desert graben has a gently dipping pediment on the eastern side that slopes toward Coyote Lake. This broad pediment lacks a distinctive nick point at its upper margin. There is a low drainage divide east of Coyote Lake basin. Intermittent streams drain east and northeastward from this divide. Both Alvord Desert and Coyote Lake are internally drained.

The highest point in the GRA is over 9,000 feet along Steens Mountain on the western margin of the GRA. The lowest area is in the northeast corner of the GRA and is less than 4,000 feet above sea-level. Local relief is as high as 4,500 feet along the fault-scarp on the western side of the Alvord Desert graben.



2.2.2 Lithology and Stratigraphy

Paleozoic and Mesozoic units may occur at undetermined depths in the Alvord Desert GRA because this area is within the margins of both the western Triassic and the western Late Paleozoic depositional basins⁽⁹⁾. None of these units however, are exposed in or near the area. Tertiary basalt flows are the oldest rocks exposed in the Alvord Desert GRA (Figure 2-2).

The majority of rocks in this GRA are Tertiary volcanogenic strata and Quaternary alluvium and colluvium. The Tertiary volcanic rocks comprise basalts, andesites, and silicic flows, tuffs, and ash-flow tuffs. Basaltic and andesitic rocks underlie most of the Sheephead Mountain GRA. These rocks are probably related to the widespread calc-alkalic volcanism associated with subduction along the Pacific margin.

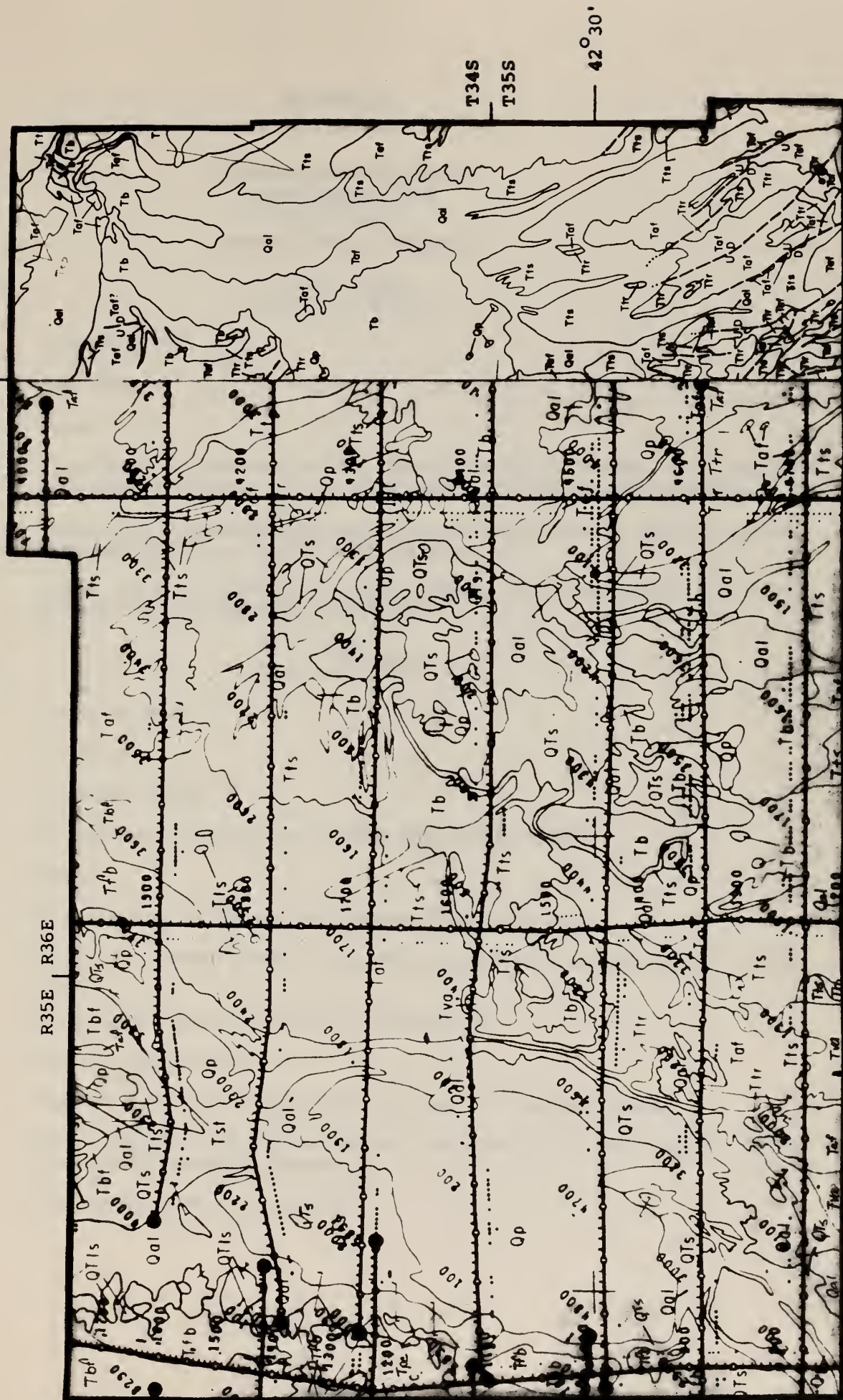
Representatives of a second Tertiary volcanic group, Min-Miocene dacitic to rhyolitic flows and ash-flow tuffs, occur throughout the Alvord Desert GRA. Some of these rocks are peralkaline or have peralkaline affinities. They are related to the beginning of extensional tectonics in the area. Associated with the second Tertiary volcanogenic episode is a series of tuffaceous fluvio-lacustrine shales, mudstones, sandstones, conglomerates, and fanglomerates. Air-fall tuff and diatomaceous sedimentary rocks also may occur in this sequence.

A third volcanic group consists mostly of Middle to Late Miocene olivine basalt flows. These rocks are correlative with the flood basalts of the Columbia Plateau Province. Relatively young basalt flows and other volcanic ejecta occur in the northern and southeastern parts of the Alvord Desert GRA.

Quaternary exogenous domes, flows, and flow breccias of rhyodacitic composition occur in parts of the Alvord Desert GRA. A small amount of Late Pleistocene or Recent basalt also occurs in parts of the area.

FIGURE 2-2

Geologic Map
Alvord Desert GRA
(OR-023-19)
Harney County, Oregon



Scale 1:250,000
(Adel and Jordan Valley 1°x2° NTMS Quadrangles)


FIGURE 2-2
(Continued)

**Geologic Map Legend For
Alvord Desert GRA
(OR-023-19)
Harney County, Oregon**

Jordan Valley,
(East of 118°00')

- Qp - Playa Deposits
- Qal - Alluvium
- Tb - Basalt
- Tts - Tuffaceous Sedimentary Rocks, Tuffs, and Silicic Flows: Fine-grained tuffaceous sedimentary rocks, flood-plain and shallow-lake deposits.
- Ttr - Tuffaceous Sedimentary Rocks, Tuffs, and Silicic Flows: Partly to densely welded tuffs and rhyolite or dacite flows
- Taf - Flows and Flow Breccias: Andesite flows, with minor basalt and interbedded tuff and tuffaceous sediments.

Adel
(West of 118°00')

- Qp - Playa Deposits
- Qal - Alluvium
- QTls - Landslide Debris
- QTs - Lacustrine, Fluvial, and Aeolian Sedimentary Rocks
- Tb - Basalt
- Tts - Fine-Grained Tuffaceous Sedimentary Rocks and Tuffs
- Ttr - Partly to Densely Welded Tuffs and Areal-Restricted Rhyolite or Dacite Flows
- Tfb - Basalt and andesite Flows and Flow Breccias
- Taf - Platy Andesite Flows
- Tbf - Massive Basalt Flows with Minor Interbeds of Tuff and Scoria
- Tva - Flows of Platy Andesite and Basaltic Andesite, with Glassy, Black or Gray Dacite or Rhyodacite
-  - Fault (dashed where inferred).



2.2.3 Structural Geology

The tri-state area of northeastern Nevada, southern Oregon, and southwestern Idaho is characterized by several major structural elements. During the Early Paleozoic this area was the site of marine sedimentation in the north-northeast trending Cordilleran geosyncline. Sedimentation persisted in three sub-parallel belts until the end of the Devonian Period. One sedimentation belt was located in the eastern half of Nevada and received nearshore to littoral deposits of shallow-water carbonates with a minor amount of interbedded shale and sandstone. The second sedimentation belt was in the western half of the state and was the locus of transitional, progressively deeper water deposits. The third belt, located further west, was the site of eugeoclinal deposits.

In Late Devonian time, the Antler Orogeny developed along a north-northeast trending swath through northwest Elko County, Nevada, and on into southwestern Idaho. The Alvord Desert GRA lies west of the axis of the Antler orogenic belt. As a direct result of the Antler orogenic uplift, a Pennsylvanian clastic wedge developed along the margins of the uplift. The orogeny culminated in a period of extensive thrust faulting that includes the Roberts' Mountain thrust.

The Sonoma Orogeny occurred in the Permian in north-central Nevada⁽⁹⁾. This deformational episode included more thrust faulting south of the Alvord Desert GRA.

Another structural episode in this area was Basin and Range block faulting in response to extensional forces. Present structures within the Alvord Desert GRA are direct result of the Basin and Range taphrogenic episode. North-trending normal faults are abundant in the area. Numerous linears have been detected and identified from aerial photographs and LANDSAT imagery⁽¹⁶⁾. Many of these linears may be fault structures. Some of the faults in this area have displacements of up to 1,000 feet.

The prominent graben-bounding faults and fault line scarps are the most notable structural features in the Alvord Desert GRA. Steeply dipping faults and fault systems are of particular importance for the development of conduits for hydrothermal systems.

2.2.4

Paleontology

Although no significant fossil localities have been reported from within the GRA, the type locality for the Alvord Creek Miocene flora occurs just outside the northwest corner of the GRA, along Big Alvord Creek⁽¹⁰⁾. Opalized shales in which these flora are found along Big Alvord Creek also occur in the GRA. Other tuffaceous sedimentary units within the Alvord Desert GRA may contain fossils. None have been formally reported; the proper litho-environmental setting for their existence and preservation does exist within the GRA.

2.2.5

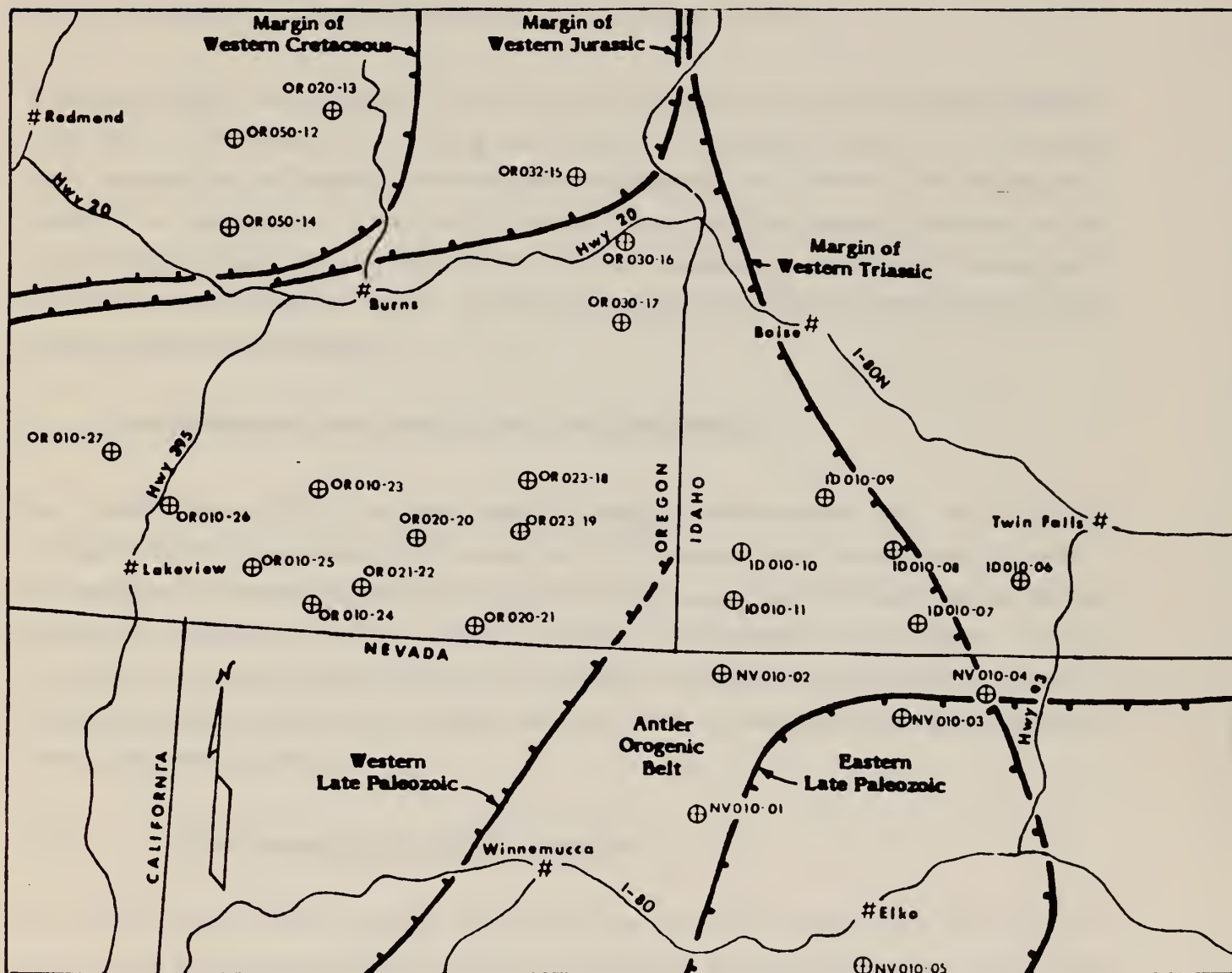
Historical Geology

The present geologic character of the Great Basin resulted from the progressive development of the western portion of the North American continent throughout geologic time. Beginning in the Late Precambrian and continuing into the Middle Paleozoic, eastern Nevada, western Utah, southwesternmost Idaho were characterized by a miogeoclinal environment in which shelf margin carbonates, shales, and sandstones were deposited. In contrast, western Nevada and southern Oregon were in a eugeoclinal environment in which dark shales, radiolarian cherts and basaltic materials (Steinman's Trinity) were formed.

The Middle Paleozoic (Late Devonian-Early Mississippian) Antler Orogeny deformed and thrust the eugeoclinal sediments over the shelf-type sediments to the east, resulting in a north-trending highland in Central Nevada. A vast amount of fine-grained detritus was shed eastward during the Mississippian, producing thick upper Paleozoic shales in eastern Nevada and western Utah. Erosion of the Antler Highlands resulted in the deposition of coarse sediments during the Early Pennsylvanian. Some of these sediments may be present at depth in the Sheephead Mountain GRA. Thousands of feet of sandstone and conglomerate were deposited in northern Nevada around the margins of the Antler Highlands. Late Pennsylvanian and Permian shallow water sediments overlapped and overstepped the roots of the eroded highlands. Sediments deposited over the eroded Antler Highlands in the Permian were predominantly of the deep-water variety. The next significant tectonic episode (the Sonoma Orogeny) thrust the ocean floor siliceous and volcanic materials eastward over the shallow-water, clastic sedimentary rocks that covered the ancient Antler Highland.



FIGURE 2-3
Paleogeographic Map⁽⁹⁾
Oregon-Idaho-Nevada
Tri-State Area



Development of western North America in the Mesozoic was dominated by oceanic plate subduction along the continental margin that resulted in a complex history of concomitant sedimentation, deformation, and igneous activity. During this time, the well-defined overthrust belt that extends from Canada to Mexico was formed. This deformation occurred during the Sevier (Late Jurassic to Latest Cretaceous) and Laramide orogenies (Latest Cretaceous to Early Tertiary Eocene).

Widespread silicic volcanic rocks formed in the Great Basin in Early and Middle Cenozoic time (20-34 million years ago). During Late Cenozoic time volcanic activity of the Great Basin changed to a bimodal basalt-rhyolite assemblage that reflects the taphrogenic character of the region. It was also during this time that the tectonic character of the region changed from one of compression to one of extension and led to the development of the Basin and Range structure. Quaternary basalts in the Sheephead Mountain GRA may be related to this episode.

2.3 ENVIRONMENTS FAVORABLE FOR GEM RESOURCES

The Alvord Desert GRA contains several geologic environments that are variously favorable for the occurrence GEM resources. All favorable environments are related to the petrogenic character of the host rocks (including diagenetic modifications) and to the taphrogenic character of the Tertiary structural development of the area. Young volcanics and deep structures provide environments favorable for geothermal resources. Tuffaceous silicic sediments and silicic ash-flow fuffs are the proper potential hosts for several industrial minerals.

2.3.1 Environments for Metals Resources

The Alvord Desert GRA contains Middle to Late Tertiary volcanic and volcanoclastic rocks, some of which have been significantly opalized. South and southwest of the GRA similar rocks contain mercury deposits (in the McDermitt Caldera), and precious opal has been found in similar rocks in northern Nevada⁽¹¹⁾. Occurrences of mercury are also found along the Steens Mountain scarp. Volcanogenic environments are favorable for the occurrence of metallic deposits. However, there is no direct evidence that the mineralizing process has occurred in the GRA.

2.3.2 Environments for Oil and Gas Resources

The Alvord Desert GRA is within the boundary of the western Triassic marine basin and is within the limits of the Miocene Lake Bruneau deposits. Late Paleozoic marine strata may be present at depth and may represent suitable source and host rocks⁽⁹⁾. Although there is no direct evidence of the presence of hydrocarbons at depth, the area is heavily leased. Prospective host rocks are all buried under the thick cover of Tertiary volcanics.

2.3.3 Environments for Oil Shale and Tar Sands Resources

The Alvord Desert GRA contains no environments favorable for the occurrence of oil shale or oil impregnated sand⁽¹²⁾. The area is underlain predominantly by Tertiary volcanics. Potential sedimentary hosts are largely tuffaceous and contain only minor amounts of non-volcanic clastic material and carbonates. Favorable lithologies are not present.

2.3.4 Environments for Geothermal Resources

Environments in the Alvord Desert GRA that are favorable for geothermal resources are strongly related to deep structures and topographic position. The presence of relatively young volcanics in the area also is a positive criterion. The steep fault structures that border the Alvord graben are prime localities for the occurrence of surface geothermal manifestations⁽¹³⁾. Mickey Hot Spring, which is located at the northern end of WSA 2-73A, is an example of this. Where fault structures are less apparent, the confidence and degree of favorability in the potential geothermal resource diminishes. The Coyote Lake area is an example of this.

2.3.5 Environments for Uranium and Thorium Resources

There are no environments favorable for the occurrence of uranium or thorium resources in the Alvord Desert GRA⁽¹⁴⁾. Favorable source rocks, potential reductants, and evidence of inferred geologic processes of mineralization are all lacking in this study area.

2.3.6 Environments for Coal Resources

The Alvord Desert GRA contains low favorability for the occurrence of coal and lignite deposits⁽¹⁵⁾. The chances for coal or carbonaceous materials to have formed in the Alvord Desert GRA are remote. The geology of the Alvord Desert GRA region does not support environments favorable for the formation of coal deposits. The area is underlain or is mantled with accumulations of highly tuffaceous sediments and related volcanic products. There is no evidence to support the inference that a coal-forming environment existed within the Alvord Desert GRA.

2.3.7 Environments for Industrial Minerals Resources

The Alvord Desert GRA contains many of the proper rocks necessary for the development of zeolites (tuffaceous lacustrine units and tuffs), diatomite (lacustrine environment), and bentonite (feldspathic volcanics and volcaniclastics). These units are wide spread throughout the GRA⁽¹⁶⁾. However, in order to contain these resources the original volcanogenic rocks must have been diagenetically altered (with the exception of diatomite). There is no evidence that the rocks of the Alvord Desert GRA have undergone the necessary alteration processes.

2.3.8 Environments for Paleontological Resources

The Alvord Desert GRA contains an opalized shale unit in which an extensive flora has been found just outside the GRA⁽¹⁰⁾. Other lacustrine and fluvial sediments may also contain fossil assemblages. The lithologies have the proper characteristics for Tertiary taphotopes but, to date, no fossils have been reported from the Alvord Desert GRA.

2.3.9 Environments for Geologic Hazards

Potential geologic hazards in the Alvord Desert GRA consist of mapped and interpreted faults, landslides, and/or volcanic centers⁽¹⁶⁾. These features were noted from aerial photographs, geologic maps, and topographic maps. There is no historical record of violent seismic or volcanic activity the area. The potential for mass movement exists along all over-steepened slopes within the GRA.



2.3.10 Educational and Scientific Localities

There are no known ESLs in the Alvord Desert GRA.



3. ENERGY AND MINERAL RESOURCES IN THE ALVORD DESERT GRA

The Alvord Desert GRA contains one environment that is highly favorable for geothermal resources, environments that are moderately favorable for oil and gas and paleontological resources, and several environments that have a low favorability for metals, geothermal, coal, clinoptilolite, diatomite, and bentonite. There are no environments in the Alvord Desert GRA that are favorable for other GEM resources.

3.1 KNOWN DEPOSITS

The Alvord Desert GRA has no known deposits. However, Mickey Hot Spring at the northern end of WSA 2-73A could be considered a geothermal "deposit."

3.2 OCCURRENCES

The Alvord Desert GRA contains 15 MILS occurrences. These consist of ten occurrences of mercury minerals, three geothermal occurrences (including Mickey Hot Spring), two occurrences of uranium, one occurrence of clinoptilolite, and one occurrence of borate minerals (Figure 3-1). Nearly all of these occurrences are on the Steens Mountain block along the western side of the GRA. Only one geothermal occurrence is within a WSA boundary (Figure 3-1 and Appendix B).

3.3 CLAIMS

There are 71 reported mining claims within the Alvord Desert GRA. All of the claims are along the Steens Mountain scarp on the western side of the GRA. Claims data are current as of 15 August, 1982.

3.4 LEASES

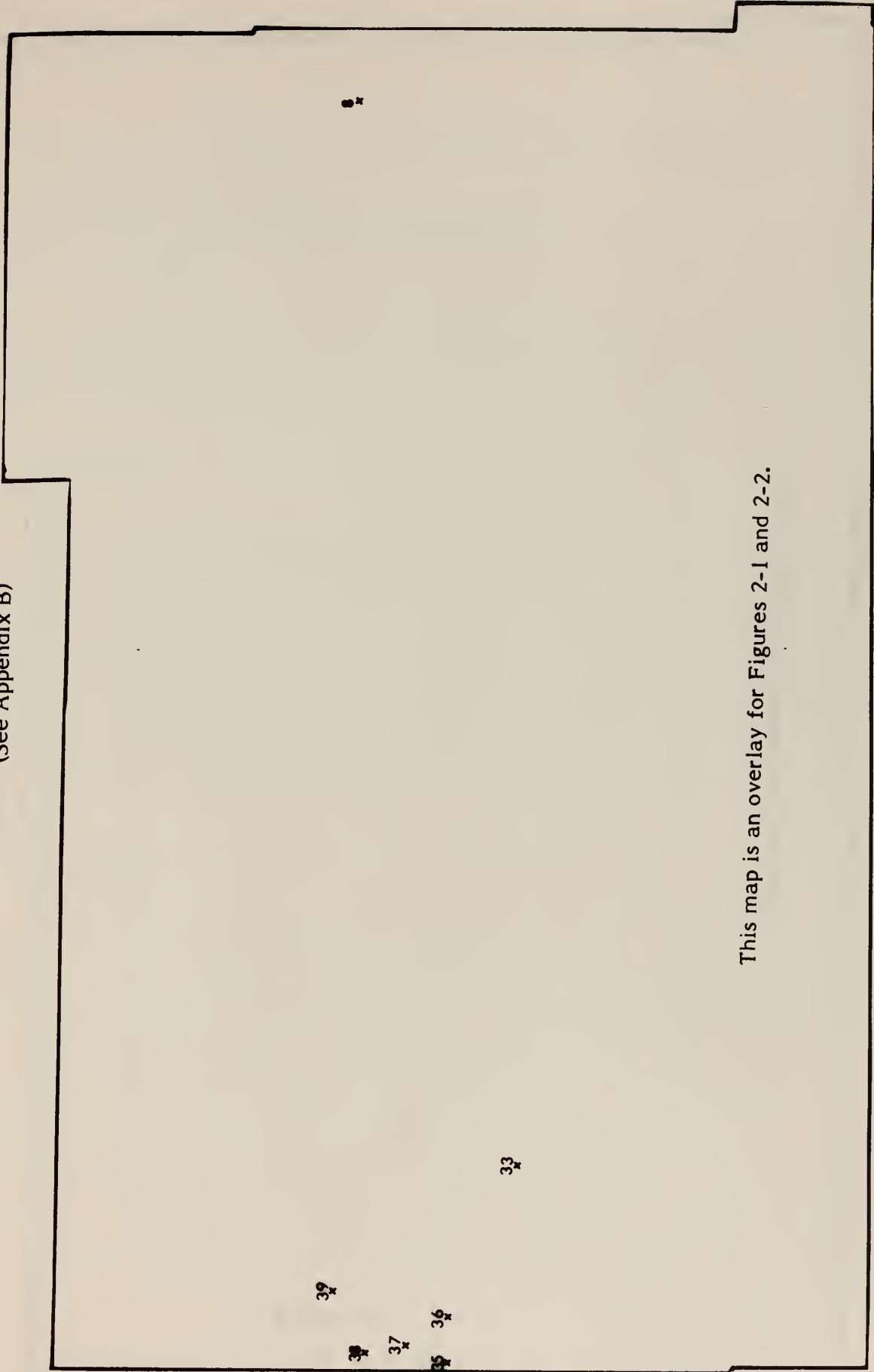
Over 50 percent of the Alvord Desert GRA is leased or is under lease application, (as of 15 August 1982). Some of this leasing activity is for geothermal resources



FIGURE 3-1

MILS Localities Map
Alvord Desert GRA
(OR - 023 - 19)
Harney County, Oregon
(See Appendix B)

39
x = Site Keyed To Explanation



This map is an overlay for Figures 2-1 and 2-2.



FIGURE 3-2

Claims Density Map
Alvord Desert GRA
(OR - 023 - 19)
Harney County, Oregon

n = number of claims per section

7 10
2 15 4
7 1
2 1
22

This map is an overlay for Figures 2-1 and 2-2.

Scale 1:250,000
(Adel and Jordan Valley 1°x2° NTMS Quadrangles)



3.5 DEPOSIT TYPES

There are no known deposits within the Alvord Desert GRA. Expected deposit types are:

- o Mercury; vein, replacement
- o Geothermal; high and intermediate temperature
- o Coal, zeolite, ciatomite, bentonite: stratiform.

3.6 MINERAL ECONOMICS

The Alvord Desert GRA is considered moderately to highly favorable for geothermal, oil and gas, and paleontological resources.

3.6.1 Geothermal

Geothermal resources may be classified into two general categories; low-temperature resources (96°F to 196°F), and high-temperature resources (196°F to 302°F). Uses of low-temperature geothermal resources include local industrial, agricultural, and domestic heating applications. High-temperature geothermal resources currently are used only in limited commercial electrical generation and research applications. Supply, demand, and price data are not established for this resource because of the limited amount of production. The importance of geothermal resources is generally of a local nature⁽¹³⁾.

3.6.2 Oil and Gas

Oil and gas are vitally important to the industrial growth and development of the United States, and to the overall standard of living. Gross supply and demand trends indicate that during the present decade foreign oil will make up at least 45 percent of our national oil requirements. Present domestic production is 8.6 million barrels per day. The United States currently has a 37 million barrel per day equivalent energy demand. It is predicted that by 1990 the United States will produce 8.8 million barrels of oil per day. The equivalent energy demand will increase to 40 million barrels per day⁽¹⁷⁾. During this same period, crude oil demand will decrease by nearly 5 percent, from 16 million barrels per day to 14 million barrels per day equivalent. This decrease is thought to be related to an increase in the use and development of other domestic energy sources, consumer conservation practices, and a predicted slight increase in crude oil production by 1990⁽¹⁷⁾. Because most shallow sources of crude have been or are being depleted,



deeper, more difficult targets of oil and gas are being sought. This may result in a rise in the price of crude by 1990 to \$61.00 per barrel⁽¹⁷⁾. This may reverse the trend of surplus supplies that began last year. It also may cause shortages⁽¹⁸⁾.

3.7 STRATEGIC AND CRITICAL MINERALS AND METALS

Mercury is the only strategic commodity for which the Alvord Desert GRA is considered potentially favorable. (See Table 3-4 in TERRADATA's report entitled "Procedures for the Assessment of Geology, Energy, and Minerals (GEM) Resources.") The entire Sheepshead Mountain GRA has a low classification for mercury.



4. CLASSIFICATION OF LAND FOR GEM RESOURCES POTENTIAL

The precise location of specific favorable environments within a given GRA depends upon three principal factors:

- o The precision and specificity of available data;
- o The nature (size and spatial distribution) of anticipated deposits as predicted from known models; and
- o The geometry of the favorable geologic environments.

Commodity-specific information in the Alvord Desert GRA is limited. Sub-surface information is virtually non-existent. Therefore, with the exception of geothermal, diatomite, and clinoptilolite resources, the entire area, rather than specific subareas, has been classified for individual GEM resources (Figure 4-1 and Table 4-1).

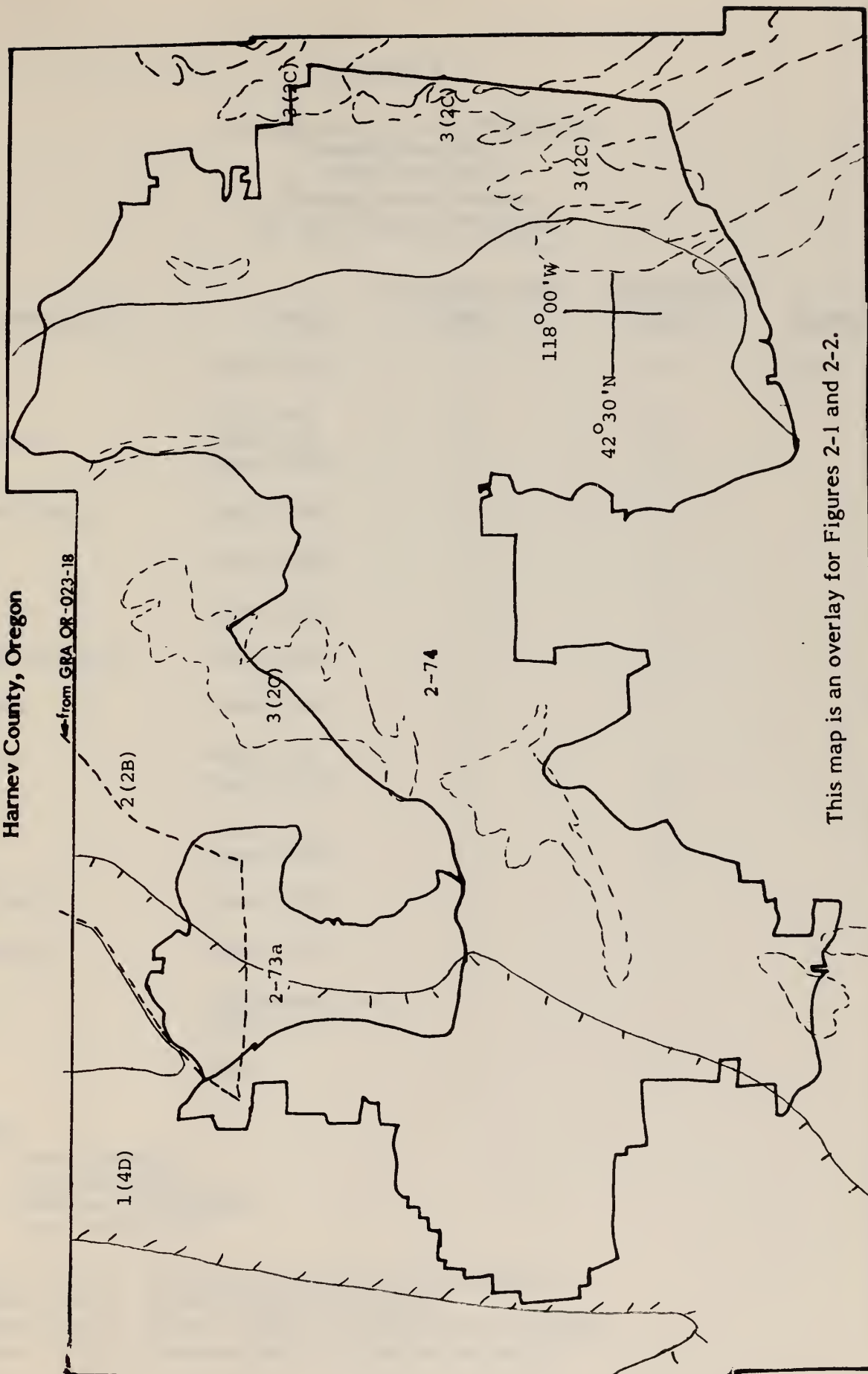
Lowland areas of the Alvord Desert GRA that are associated with young volcanics and deep structures, and hot springs are highly favorable (Class 4) for geothermal resources. Similar areas which may have pronounced structures and in which there are few if any surface manifestations of geothermal resources have low favorability (Class 2). With the exception of environments favorable for the occurrence of paleontological resources, all other environments within the GRA have a low favorability for various GEM resources. Several lithostratigraphic units are favorable for zeolite and diatomite resources. These include lacustrine sediment-bearing units. They have an equal likelihood of occurring anywhere within the GRA. These environments also are favorable for mercury and, to a lesser extent, coal. The entire Alvord Desert GRA is favorable for these latter resources but sufficient commodity-specific information is not available to subdivide the area into environments of different favorability. The Alvord Desert GRA is not favorable for other GEM resources.

The TERRADATA classification of geothermal resources in the Alvord Desert GRA is in close agreement with the prospectively valuable and KGRA designations of the area by the USGS⁽¹⁹⁾. It is also in agreement with the USGS designation of the area for oil and gas "prospectively valuable"⁽²⁰⁾. Because of the lack of any sub-surface information (except for one MILS occurrence) from the Alvord Desert or Coyote Lake playas, TERRADATA did not evaluate the area for potential evaporative salts. Portion of the Alvord Desert GRA have been designated as "prospectively valuable" for sodium salts by the USGS⁽²¹⁾.



FIGURE 4-1

Land Classification Map
Alvord Desert GRA
(OR - 023 - 19)
Harney County, Oregon



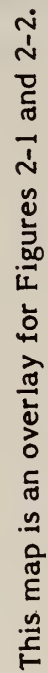
Scale 1:250,000
(Adel and Jordan Valley 1°x2° NTMS Quadrangles)

TERRADATA

San Francisco
Denver



**Land Classification Map
Alvord Desert GRA
(OR - 023 - 19)
Harney County, Oregon**



San Francisco
Denver

Scale 1:250,000
(Adel and Jordan Valley 1°x2° NTMS Quadrangles)

TABLE 4-1

**Classification Of Lands Within The
Alvord Desert GRA
(OR - 023 - 19)
Harney County, Oregon
For GEM Resource Potential**

<u>COMMODITY</u>	<u>AREA</u>	<u>CLASSIFICATION LEVEL</u>	<u>CONFIDENCE LEVEL</u>	<u>REMARKS</u>
Metals	Entire GRA	2	B	Hg
Geothermal	Area 1-4D	4	D	
	Area 2-2B	2	B	
	Rest of GRA	1	B	
Uranium/Thorium	Entire GRA	1	A	
Coal	Entire GRA	2	C	
Oil and Gas	Entire GRA	3	B	
Tar Sands/Oil Shale	Entire GRA	1	C	
Limestone	Entire GRA	1	C	
Bentonite	Area 3-2C	2	C	
	Rest of GRA	1	B	
Diatomite	Area 3-2C	2	C	
	Rest of GRA	1	B	
Clinoptilolite	Entire GRA	2	C	
Paleontology	Entire GRA	3	C	
Hazards	See Hazards Map (GRA File)			
ESLs	None	1	C	

LEGEND:

Class 1 - Least Favorable
Class 2 - Low Favorability
Class 3 - Moderate Favorability
Class 4 - High Favorability

Confidence Level A - Insufficient data or no direct evidence
Confidence Level B - Indirect evidence available
Confidence Level C - Direct evidence but quantitatively minimal
Confidence Level D - Abundant direct and indirect evidence



5. RECOMMENDATIONS FOR FUTURE WORK

Further work in the Alvord Desert GRA should be designed to increase the confidence levels of the classifications. Detailed surface investigations should be undertaken for recognition criteria for industrial minerals (e.g., environmental phenomena that might produce bentonite or clinoptilolite; ash flow tuffs with possible basal vitrophyres for perlite, etc.); and for additional metallic deposits (soil chemistry, stream sediment analyses, etc). With the exception of either geophysical investigations or drilling, future work should be confined to detailed mapping, geochemical sampling, and general field exploration.



- APPENDIX A -

References Cited



REFERENCES CITED

1. Cook, J.R., Fay, W.M.; 1982; Data report: Western United States; Savannah River Laboratory, United States Department of Energy, Open-File Report GJB X-132(82), 34p., 54 fiche.
2. Fay, W.M., Cook, J.R.; 1982; Gold analysis by neutron activation from Savannah River Laboratory National Resource Uranium Evaluation samples; Savannah River Laboratory, United States Department of Energy, Open-File Report GJB X-135(82), 46p.
3. Geodata International, Inc.; 1979; Aerial radiometric and magnetic survey, Adel national topographic map, Oregon; United States Department of Energy, Open-File Report GJB X-104(80), 153p., 112 fiche.
4. Berry, M.R., Castor, S.B., and Robins, J.W.; 1982; National uranium resource evaluation, Jordan Valley quadrangle, Oregon and Idaho; United States Department of Energy, Open-File Report PGJ/F-132(82), 40p.
5. Oak Ridge Gaseous Diffusion Plant; 1982; Hydrogeochemical and stream sediment basic reconnaissance data for Jordan Valley quadrangle, Oregon, Idaho; United States Department of Energy, Open-File Report GJB X-58(82), 97p., 1 fiche.
6. Geodata International, Inc.; 1980; Aerial radiometric and magnetic survey, Jordan Valley national topographic map, Oregon, Idaho; United States Department of Energy, Open-File Report GJB X-95(80), 203p., 108 fiche.
7. Dole, H.M., and Weisenborn, A.E. (Editors); 1969; Mineral and water resources of Oregon; Report to the Committee on Interior Affairs, United States Senate, 90th Congress, Second Session.
8. McIntosh, W.L., and Eister, M.F.; 1981; Geologic map index of Oregon; United States Geological Survey.
9. Newton, V.C., Jr.; 1982; Geology, energy, and minerals resources appraisal, BLM Region I, Columbia Plateau - oil and gas; for TERRADATA, Lakewood, Colorado, unpublished report (this report has been placed in the appropriate GRA files), 20p., plates.
10. Firby, J.; 1982; Geology, energy, and minerals resources appraisal, BLM Region I, Columbia Plateau - paleontology; for TERRADATA, Lakewood, Colorado, unpublished report (this report has been placed in the appropriate GRA files), 124p.
11. Weis, P.L.; 1982; Geology, energy, and minerals resources appraisal, BLM Region I, Columbia Plateau - metals and non-metals; for TERRADATA, Lakewood, Colorado, unpublished report (this report has been placed in the appropriate GRA files), 24p.



12. Budding, A.; 1982; Geology, energy, and minerals resources assessment, BLM Region I, Columbia Plateau - oil shale and tar sands; for TERRADATA, Lakewood, Colorado, unpublished report (this report has been placed in the appropriate GRA files), 12p.
13. Youngquist, W.; 1982; Geology, energy, and minerals resources appraisal, BLM Region I, Columbia Plateau - geothermal; for TERRADATA, Lakewood, Colorado, unpublished report (this report has been placed in the appropriate GRA files), 65p.
14. Miller, R.; 1982; Geology, energy, and minerals resources assessment, BLM Region I, Columbia Plateau - uranium and thorium; for TERRADATA, Lakewood, Colorado, unpublished report (this report has been placed in the appropriate GRA files), 15p.
15. Mason, R.S.; 1982; Geology, energy, and minerals resources appraisal, BLM Region I, Columbia Plateau - coal; for TERRADATA, Lakewood, Colorado, unpublished report (this report has been placed in the appropriate GRA files), 5p.
16. Schlicker, H.G.; 1982; Geology, energy, and minerals resources appraisal, BLM Region I, Columbia Plateau - industrial minerals and geologic hazards; for TERRADATA, Lakewood, Colorado, unpublished report (this report has been placed in the appropriate GRA files), 56p.
17. Corey, J.H.; 1982; Funding the United States petroleum industry; Oil and Gas Journal, Vol. 80, No. 45, pp.152-167.
18. Burris, N.; 1982; The oil industry in transition; Oil and Gas Journal, Vol. 80, No. 45, pp.174-180.
19. Godwin, L.H., Lee, W.H., and Moore, S.; 1980; Lands valuable for geothermal resources map for the State of Oregon; Revised, United States Geological Survey, Minerals Management Service, Menlo Park, California, Scale 1:500,000.
20. Smith, M.B.; 1976; Lands valuable for oil and gas map for the State of Oregon; Revised, United States Geological Survey, Minerals Management Service, Menlo Park, California, Scale 1:500,000.
21. Blank, J.; 1978; Lands valuable for sodium and potassium map for the State of Oregon; Revised, United States Geological Survey, Minerals Management Service, Menlo Park, California, Scale 1:500,000.



- APPENDIX B -
Explanation For Figure 3-1



FIGURE 3-1 (Explanation)

35
8 NAME- JUDOR 5 SPRINGS REFERENCE NUMBER- 0410450076
STATE- OREGON COUNTY- MALHEUR ELEV:PREC- 1219M:500M
LATITUDE- N 42 26 10 PRECISION- 1KM
LONGITUDE- W 117 53 55 REFERENCE POINT- APPROX
UTM: ZONE 11N NORTHING 4716881 EASTING 426283
PUBLIC LAND SURVEY TOWNSHIP- 034 S RANGE- 039 E
DESCRIPTION SECTION- 12 SECTION SUBDIVISION-
RIVER BASIN- 786 CROOKED CREEK DOMAIN- UNKNOWN
STATUS- PRODUCER OPERATION TYPE- WELL
MESA ID NO. YEAR FIELD CHECKED- MAP REPOSITORY- FOC
MAP NAME- JORDAN VALLEY TYPE- 1:250K
1:250,000 MAP NAME- JORDAN VALLEY MINERAL PROPERTY FILE-
PRIMARY NAME- JUDOR 5 SPRINGS
COMMOD/MOD- GEOTHERMAL
USGS PROFESSIONAL PAPER 492
24 MILES SW OF HOME. SEVERAL SPRINGS. WATER USED FOR IRRIGATION
FLOW OF 6000 GALLONS PER MINUTE.

82
32 NAME- ALVORD DESERT BORATES REFERENCE NUMBER- 0410250001
STATE- OREGON COUNTY- HARNEY ELEV:PREC- 1219M:500M
LATITUDE- N 42 31 49 PRECISION- 500M
LONGITUDE- W 118 27 24 REFERENCE POINT- APPROX
UTM: ZONE 11N NORTHING 4709468 EASTING 380365
PUBLIC LAND SURVEY TOWNSHIP- 035 S RANGE- 034 E
DESCRIPTION SECTION- 01 SECTION SUBDIVISION-
RIVER BASIN- 67M MALHEUR/HARNEY LK BS DOMAIN- UNKNOWN
STATUS- RAW PROSPECT OPERATION TYPE- PROSPECT
MESA ID NO. YEAR FIELD CHECKED- MAP REPOSITORY- FOC
MAP NAME- ADEL TYPE- 1:250K
1:250,000 MAP NAME- ADEL MINERAL PROPERTY FILE-
PRIMARY NAME- ALVORD DESERT BORATES
COMMOD/MOD- BORON SODIUM SALT

85
35 NAME- JACK POT CLAIMS REFERENCE NUMBER- 0410250023
STATE- OREGON COUNTY- HARNEY ELEV:PREC- 1768M:500M
LATITUDE- N 42 33 17 PRECISION- 500M
LONGITUDE- W 118 23 05 REFERENCE POINT- APPROX
UTM: ZONE 11N NORTHING 4712301 EASTING 372635
PUBLIC LAND SURVEY TOWNSHIP- 034 S RANGE- 034 E
DESCRIPTION SECTION- 30 SECTION SUBDIVISION-
RIVER BASIN- 67M MALHEUR/HARNEY LK BS DOMAIN- UNKNOWN
STATUS- EXP PROSPECT OPERATION TYPE- UNDERGROUND
MESA ID NO. YEAR FIELD CHECKED- MAP REPOSITORY- FOC
MAP NAME- ADEL TYPE- 1:250K
1:250,000 MAP NAME- ADEL MINERAL PROPERTY FILE-
PRIMARY NAME- JACK POT CLAIMS
COMMOD/MOD- MERCURY

87
35 NAME- LAST CHANCE CLAIMS REFERENCE NUMBER- 0410250020
STATE- OREGON COUNTY- HARNEY ELEV:PREC- 1951M:500M
LATITUDE- N 42 33 23 PRECISION- 500M
LONGITUDE- W 118 33 38 REFERENCE POINT- APPROX
UTM: ZONE 11N NORTHING 4712319 EASTING 371885
PUBLIC LAND SURVEY TOWNSHIP- 034 S RANGE- 034 E
DESCRIPTION SECTION- 30 SECTION SUBDIVISION-
RIVER BASIN- 67M MALHEUR/HARNEY LK BS DOMAIN- UNKNOWN
STATUS- EXP PROSPECT OPERATION TYPE- PROSPECT
MESA ID NO. YEAR FIELD CHECKED- MAP REPOSITORY- FOC
MAP NAME- ADEL TYPE- 1:250K
1:250,000 MAP NAME- ADEL MINERAL PROPERTY FILE-
PRIMARY NAME- LAST CHANCE CLAIMS
COMMOD/MOD- MERCURY



FIGURE 3-1
(Explanation Continued)

35 NAME- GEOTHERMAL WELL REFERENCE NUMBER- 0410250019
STATE- OREGON COUNTY- HARNEY ELEV:PREC- 1250M:500M
LATITUDE- N 42 32 40 PRECISION- 500M
LONGITUDE- W 118 41 47 REFERENCE POINT- APPROX
ZONE 11N NORTHING 471147 EASTING 374303
PUBLIC LAND MAPS- TOWN SHIP- 034 S RANGE- 034 E
DESCRIPTION- SECTION- 21 SECTION SUBDIVISION- SE
RIVER BASIN- 07M MALHEUR/HARNEY LK BS DOMAIN- UNKNOWN
STATUS- FRODOHER OPERATION TYPE- WELL
WESA ID NO. YEAR FIELD CHECKED- MAP REPOSITORY- FOC
MAP NAME- ADEL TYPE- 1:250K
1:250,000 MAP NAME- ADEL MINERAL PROPERTY FILE-
PRIMARY NAME- GEOTHERMAL WELL
OTHER NAMES- HEDNER ROCK PRODUCTS; BOB HEBENER
COMMON MOD- GEOTHERMAL
JESS PROFESSIONAL PAPER 492
ON WEST BORDER OF THE ALVORD DESERT 6 MILES SOUTH OF ALVORD
SEVERAL SPRINGS. WATER USED LOCALLY.

36 NAME- FOTHOLL CLAIMS REFERENCE NUMBER- 0410250021
STATE- OREGON COUNTY- HARNEY ELEV:PREC- 1707M:500M
LATITUDE- N 42 33 24 PRECISION- 500M
LONGITUDE- W 118 32 10 REFERENCE POINT- APPROX
ZONE 11N NORTHING 4712513 EASTING 373892
PUBLIC LAND MAPS- TOWN SHIP- 034 S RANGE- 034 E
DESCRIPTION- SECTION- 21 SECTION SUBDIVISION-
RIVER BASIN- 07M MALHEUR/HARNEY LK BS DOMAIN- UNKNOWN
STATUS- EXP PROSPECT OPERATION TYPE- PROSPECT
WESA ID NO. YEAR FIELD CHECKED- MAP REPOSITORY- FOC
MAP NAME- ADEL TYPE- 1:250K
1:250,000 MAP NAME- ADEL MINERAL PROPERTY FILE-
PRIMARY NAME- FOTHOLL CLAIMS
COMMON MOD- MERCURY

37 NAME- ALEXANDER MINE REFERENCE NUMBER- 0410250018
STATE- OREGON COUNTY- HARNEY ELEV:PREC- 1829M:500M
LATITUDE- N 41 34 00 PRECISION- 500M
LONGITUDE- W 118 32 00 REFERENCE POINT- APPROX
ZONE 11N NORTHING 471311 EASTING 372773
PUBLIC LAND MAPS- TOWN SHIP- 034 S RANGE- 034 E
DESCRIPTION- SECTION- 20 SECTION SUBDIVISION- NE
RIVER BASIN- 07M MALHEUR/HARNEY LK BS DOMAIN- UNKNOWN
STATUS- EXP PROSPECT OPERATION TYPE- UNDERGROUND
WESA ID NO. YEAR FIELD CHECKED- MAP REPOSITORY- FOC
MAP NAME- ADEL TYPE- 1:250K
1:250,000 MAP NAME- ADEL MINERAL PROPERTY FILE-
PRIMARY NAME- ALEXANDER MINE
COMMON MOD- MERCURY



FIGURE 3-1
(Explanation Continued)

51
37 NAME- JUNIPER MERCURY MINE REFERENCE NUMBER- 0410250045
STATE- OREGON COUNTY- HARNEY ELEV:PREC- 1829M:500M
LATITUDE- N 42 33 56 PRECISION- 1KM
LONGITUDE- W 118 23 21 REFERENCE POINT- APPROX
UTM: ZONE 11N NORTHING 4713530 EASTING 372292
PUBLIC LAND SURVEY TOWNSHIP- 034 S RANGE- 034 E
DESCRIPTION SECTION- 30 SECTION SUBDIVISION-
RIVER BASIN- 67M MALHEUR&HARNEY LK BS DOMAIN- UNKNOWN
STATUS- EXP PROSPECT OPERATION TYPE- UNDERGROUND
YESA ID NO. YEAR FIELD CHECKED- MAP REPOSITORY- FOC
MAP NAME- ADEL TYPE- 1:250K
1:250,000 MAP NAME- ADEL MINERAL PROPERTY FILE- 42.020
PRIMARY NAME- JUNIPER MERCURY MINE
COMMOD.MOD- MERCURY

62
37 NAME- PIKE CLAIMS REFERENCE NUMBER- 0410250019
STATE- OREGON COUNTY- HARNEY ELEV:PREC- 1829M:500M
LATITUDE- N 42 33 40 PRECISION- 500M
LONGITUDE- W 118 23 35 REFERENCE POINT- APPROX
UTM: ZONE 11N NORTHING 4713913 EASTING 371963
PUBLIC LAND SURVEY TOWNSHIP- 034 S RANGE- 034 E
DESCRIPTION SECTION- 30 SECTION SUBDIVISION-
RIVER BASIN- 67M MALHEUR&HARNEY LK BS DOMAIN- UNKNOWN
STATUS- EXP PROSPECT OPERATION TYPE- PROSPECT
YESA ID NO. YEAR FIELD CHECKED- MAP REPOSITORY- FOC
MAP NAME- ADEL TYPE- 1:250K
1:250,000 MAP NAME- ADEL MINERAL PROPERTY FILE-
PRIMARY NAME- PIKE CLAIMS
COMMOD.MOD- MERCURY

63
37 NAME- PIKE CREEK REFERENCE NUMBER- 0410250013
STATE- OREGON COUNTY- HARNEY ELEV:PREC- 1829M:500M
LATITUDE- N 42 34 40 PRECISION- 1KM
LONGITUDE- W 118 22 22 REFERENCE POINT- APPROX
UTM: ZONE 11N NORTHING 4714882 EASTING 373662
PUBLIC LAND SURVEY TOWNSHIP- 034 S RANGE- 034 E
DESCRIPTION SECTION- 20 SECTION SUBDIVISION-
RIVER BASIN- 67M MALHEUR&HARNEY LK BS DOMAIN- UNKNOWN
STATUS- UNKNOWN OPERATION TYPE- UNKNOWN
YESA ID NO. YEAR FIELD CHECKED- MAP REPOSITORY- FOC
MAP NAME- ADEL TYPE- 1:250K
1:250,000 MAP NAME- ADEL MINERAL PROPERTY FILE-
PRIMARY NAME- PIKE CREEK
OTHER NAMES- KISKA PROSPECT
COMMOD.MOD- URANIUM U308 CONTENT



FIGURE 3-1
(Explanation Continued)

64
37 NAME- MOAMS PROSPECT REFERENCE NUMBER- 0410250016
STATE- OREGON COUNTY- HARNEY ELEV:PREC- 1829M:500M
LATITUDE- N 42 35 02 PRECISION- 500M
LONGITUDE- W 118 34 51 REFERENCE POINT- ORE BODY
JNL ZONE 11N NORTHING 4715543 EASTING 373013
PUBLIC LAND SURVEY TOWNSHIP- 034 S RANGE- 034 E
DESCRIPTION SECTION- 18 SECTION SUBDIVISION- 5L
RIVER BASIN- RTM MALHEUR&HARNEY LK BS DOMAIN- BLM ADMIN
STATUS- EXP PROSPECT OPERATION TYPE- PROSPECT
MESA ID NO. YEAR FIELD CHECKED- MAP REPOSITORY- FOC
MAP NAME- ADEL TYPE- 1:250K
1:250,000 MAP NAME- ADEL MINERAL PROPERTY FILE-
PRIMARY NAME- BRADOS PROSPECT
OTHER NAMES- LUCK CANYON
COMMOD/MOD- MERCURY

65
37 NAME- STEENS MOUNTAINS ZEOLITES REFERENCE NUMBER- 0410250007
STATE- OREGON COUNTY- HARNEY ELEV:PREC- 1829M:500M
LATITUDE- N 42 34 21 PRECISION- 10KM
LONGITUDE- W 118 33 06 REFERENCE POINT- ORE BODY
JNL ZONE 11N NORTHING 4714215 EASTING 372648
PUBLIC LAND SURVEY TOWNSHIP- 031 S RANGE- 034 E
DESCRIPTION SECTION- 19 SECTION SUBDIVISION-
RIVER BASIN- RTM MALHEUR&HARNEY LK BS DOMAIN- BLM ADMIN
STATUS- RAW PROSPECT OPERATION TYPE- PROSPECT
MESA ID NO. YEAR FIELD CHECKED- MAP REPOSITORY- FOC
MAP NAME- ADEL TYPE- 1:250K
1:250,000 MAP NAME- ADEL MINERAL PROPERTY FILE-
PRIMARY NAME- STEENS MOUNTAINS ZEOLITES
COMMOD/MOD- ZEOLITES

66
37 NAME- STEENS MOUNTAIN MINE REFERENCE NUMBER- 0410250017
STATE- OREGON COUNTY- HARNEY ELEV:PREC- 1829M:500M
LATITUDE- N 42 34 25 PRECISION- 500M
LONGITUDE- W 118 33 05 REFERENCE POINT- MAIN ENT
JNL ZONE 11N NORTHING 4714118 EASTING 372673
PUBLIC LAND SURVEY TOWNSHIP- 034 S RANGE- 034 E
DESCRIPTION SECTION- 19 SECTION SUBDIVISION- L2
RIVER BASIN- RTM MALHEUR&HARNEY LK BS DOMAIN- BLM ADMIN
STATUS- DEVEL DEPOSIT OPERATION TYPE- UNDERGROUND
MESA ID NO. YEAR FIELD CHECKED- MAP REPOSITORY- FOC
MAP NAME- ADEL TYPE- 1:250K
1:250,000 MAP NAME- ADEL MINERAL PROPERTY FILE- 42.034
PRIMARY NAME- STEENS MOUNTAIN MINE
COMMOD/MOD- MERCURY
OGAMI BULL 05.1193



FIGURE 3-1
(Explanation Concluded)

67
37 NAME- STEWART PROSPECT REFERENCE NUMBER- 0410250022
STATE- OREGON COUNTY- HARNEY ELEV:PREC- 1707M:500M
LATITUDE- N 42 33 36 PRECISION- 500M
LONGITUDE- W 118 33 02 REFERENCE POINT- ORE BODY
JTM: ZONE 11N NORTHING 4712906 EASTING 372714
PUBLIC LAND SURVEY TOWNSHIP- 034 S RANGE- 034 E
DESCRIPTION SECTION- 30 SECTION SUBDIVISION- SE
RIVER BASIN- 67M MALHEURSHARNEY LK BS DOMAIN- BLM ADMIN
STATUS- EXP PROSPECT OPERATION TYPE- PROSPECT
VESA ID NO. YEAR FIELD CHECKED- MAP REPOSITORY- FOC
MAP NAME- ADEL TYPE- 1:250K
1:250,000 MAP NAME- ADEL MINERAL PROPERTY FILE-
PRIMARY NAME- STEWART PROSPECT
OTHER NAMES- AILE ROUGE
COMMOD/MOD- MERCURY
OGAMI BULL NO.P106

68
38 NAME- LUCK CANYON REFERENCE NUMBER- 0410250101
STATE- OREGON COUNTY- HARNEY ELEV:PREC- 1646M:500M
LATITUDE- N 42 35 17 PRECISION- 1KM
LONGITUDE- W 118 33 21 REFERENCE POINT- APPROX
JTM: ZONE 11N NORTHING 4716028 EASTING 372338
PUBLIC LAND SURVEY TOWNSHIP- 034 S RANGE- 034 E
DESCRIPTION SECTION- 18 SECTION SUBDIVISION- C
RIVER BASIN- 67N BLACK ROCK DESERT BS DOMAIN- UNKNOWN
STATUS- UNKNOWN OPERATION TYPE- SURFACE
VESA ID NO. YEAR FIELD CHECKED- MAP REPOSITORY- FOC
MAP NAME- ALFORD HOT SPRING TYPE- 7.5 MIN
1:250,000 MAP NAME- ADEL MINERAL PROPERTY FILE- 45.058
PRIMARY NAME- LUCK CANYON
COMMOD/MOD- MERCURY

69
39 NAME- TIMBER BEAST REFERENCE NUMBER- 0410250011
STATE- OREGON COUNTY- HARNEY ELEV:PREC- 1768M:500M
LATITUDE- N 42 36 03 PRECISION- 500M
LONGITUDE- W 118 31 23 REFERENCE POINT- MAIN ENT
JTM: ZONE 11N NORTHING 4717308 EASTING 375053
PUBLIC LAND SURVEY TOWNSHIP- 034 S RANGE- 034 E
DESCRIPTION SECTION- 03 SECTION SUBDIVISION- C
RIVER BASIN- 66M MALHEURSHARNEY LK BS DOMAIN- BLM ADMIN
STATUS- EXP PROSPECT OPERATION TYPE- SURF-UNDERG
VESA ID NO. YEAR FIELD CHECKED- MAP REPOSITORY- WFOC
MAP NAME- ADEL TYPE- 1:250K
1:250,000 MAP NAME- ADEL MINERAL PROPERTY FILE- 75.006
PRIMARY NAME- TIMBER BEAST
COMMOD/MOD- URANIUM U308 CONTENT



